

## **Buildings and the Environment: A Statistical Summary**

*December 20, 2004*

### **Introduction**

While buildings and development provide countless benefits to society, they also have significant environmental impacts. This summary presents some basic facts about those impacts. Footnotes provide links to the sources of this information, which offer much more context and detail on these issues.

EPA's Green Building Workgroup is composed of numerous EPA programs designed to address the environmental impacts of the built environment. For more information, see EPA's Green Building website at <http://www.epa.gov/greenbuilding/>.

### **Buildings – General Statistics**

#### General

- There are 223,114 establishments/businesses in the building industry, representing more than \$531 billion in annual revenues, nearly \$62 billion in annual payroll, and more than 1.7 million employees (2002).<sup>1</sup>

#### Residential Buildings

- Nearly 116 million residential buildings existed in 2000.<sup>2</sup> More than 1.8 million residential buildings are built annually (2003).<sup>3</sup>

#### Commercial Buildings

- Nearly 4.7 million office buildings existed in 1999.<sup>4</sup> Every year, approximately 170,000 commercial buildings are constructed, and nearly 44,000 commercial buildings demolished (1995).<sup>5</sup>

#### Schools

- Nearly 73 million Americans (68.5 million children) spend their days in approximately 117,007 public and private primary and secondary schools (2000).<sup>6</sup>

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<sup>1</sup> 2002 Economic Census. Census Bureau, U.S. Department of Commerce.  
<http://www.census.gov/econ/census02/advance/TABLE2.HTM>.

<sup>2</sup> General Housing Characteristics: 2000. Census Bureau, U.S. Department of Commerce.  
[http://factfinder.census.gov/servlet/GCTTable?\\_bm=y&-geo\\_id=01000US&-box\\_head\\_nbr=GCT-H5&-ds\\_name=DEC\\_2000\\_SF1\\_U&-lang=en&-format=US-9&-sse=on](http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=01000US&-box_head_nbr=GCT-H5&-ds_name=DEC_2000_SF1_U&-lang=en&-format=US-9&-sse=on)

<sup>3</sup> Annual Housing Starts (1978-2003). Census Bureau, U.S. Department of Commerce. September 2004. <http://www.census.gov/const/www/newresconstindex.html>.

<sup>4</sup> 1999 Commercial Buildings Energy Consumption Survey. Energy Information Administration, U.S. Department of Energy. 2002. <http://www.eia.doe.gov/emeu/cbecs/char99/intro.html>.

<sup>5</sup> C-Series Reports. Manufacturing and Construction Division, Census Bureau, U.S. Department of Commerce. 1995.

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### **Land Use**

- Total land area in the U.S., excluding Alaska and Hawaii, is 1.983 billion acres. 107.3 million of those acres are developed, representing an increase of 24 percent in developed land over the past 10 years (2002).<sup>7</sup>

### **Energy<sup>8</sup>**

- Buildings accounted for 39.4 percent of total U.S. energy consumption in 2002. Residential buildings accounted for 54.6 percent of that total, while commercial buildings accounted for the other 45.4 percent.
- Buildings accounted for 67.9 percent of total U.S. electricity consumption in 2002. 51.2 percent of that total was attributed to residential building use, while 48.8 percent was attributed to commercial building usage.

### **Air and Atmosphere**

- Buildings in the United States contribute 38.1 percent of the nation's total carbon dioxide emissions, including 20.6 percent from the residential sector and 17.5 percent from the commercial sector.<sup>9</sup>
- In 2001, less than 15% of students between the ages of 5-15 walked or biked to or from school, down from 48% of students in 1969. These travel choices, which are influenced by school siting and development patterns, impact air emissions.<sup>10</sup>

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<sup>6</sup> Common Core Data. National Center for Educational Statistics, U.S. Department of Education. 2002. [http://nces.ed.gov/programs/digest/d02/list\\_tables1.asp#c1\\_1](http://nces.ed.gov/programs/digest/d02/list_tables1.asp#c1_1).

<sup>7</sup> Developed land is defined as a combination of land cover/use categories: large urban and built-up areas, small built-up areas, and rural transportation land. 2002 National Resources Inventory. National Resources Conservation Service, U.S. Department of Agriculture. <http://www.nrcs.usda.gov/technical/land/nri02/nri02lu.html>.

<sup>8</sup> Annual Energy Review 2003. DOE/EIA-0384 (2003). Energy Information Administration, U.S. Department of Energy. September 2003. <http://tonto.eia.doe.gov/FTP/ROOT/multifuel/038402.pdf>.

<sup>9</sup> Emissions of Greenhouse Gases in the United States 2002. DOE/EIA-0573(2002). Energy Information Administration, U.S. Department of Energy. October 2003. <http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html>.

<sup>10</sup> Travel and Environmental Implications of School Siting. US Environmental Protection Agency. October 2003. [http://www.epa.gov/smartgrowth/school\\_travel.htm](http://www.epa.gov/smartgrowth/school_travel.htm)

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### **Water**

- Building occupants use 12.2 percent of the total water consumed in the United States per day. Of that total, 25.6 percent is used by commercial building occupants, and 74.4 percent by homeowners (1995).<sup>11</sup>
- Buildings and the transportation infrastructure that serves them replace natural surfaces with impermeable materials, creating runoff that washes pollutants and sediments into surface waters. Urban runoff is the fourth leading source of impairment in rivers, third in lakes, and second in estuaries (2000)<sup>12</sup>.

### **Indoor Environment**

#### General<sup>13</sup>

- On average, Americans spend about 90 percent or more of their time indoors.
- Indoor levels of pollutants may be two to five times higher, and occasionally more than 100 times higher, than outdoor levels.

#### Schools

- In the mid-1990s, one in five of U.S. schools reported unsatisfactory indoor air quality, and one in four schools reported ventilation as unsatisfactory.<sup>14</sup>

#### Homes

- In 1992, EPA estimated that nearly one out of every 15 homes had radon concentrations above the EPA recommended action level.<sup>15</sup>

#### Indoor Pollutants

- Sources of indoor air pollution may include: combustion sources; building materials and furnishings; household cleaning, maintenance, personal care, or

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<sup>11</sup> Estimated Water Use in the United States in 1995. U.S. Geological Survey.

<http://water.usgs.gov/watuse/pdf1995/html/>

<sup>12</sup> The National Water Quality Inventory: 2000 Report to Congress. US Environmental Protection Agency. 2000. <http://www.epa.gov/305b/2000report/>

<sup>13</sup> The Total Exposure Assessment Methodology (TEAM) Study. EPA 600/S6-87/002. U.S. Environmental Protection Agency. 1987. <http://www.epa.gov/ncepihom/>.

<sup>14</sup> Condition of America's Public School Facilities: 1999. NCES 2000 032. U.S. Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics. June 2000. <http://nces.ed.gov/surveys/frss/publications/2000032/>.

<sup>15</sup> National Residential Radon Survey: Summary Report. EPA 402-R-92-011. U.S. Environmental Protection Agency. October 1992.

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- hobby products; central heating and cooling systems and humidification devices; and outdoor sources such as radon, pesticides, and outdoor air pollution.<sup>16</sup>
- 64 million homes, 83 percent of the privately owned housing units built before 1980, have lead-based paint somewhere in the building. Twelve million of these homes are occupied by families with children under the age of seven years old.<sup>17</sup>

### Health Effects of Indoor Environmental Quality<sup>18</sup>

- Cancer:
  - Radon is the second leading cause of lung cancer and is estimated to be responsible for an estimated 21,000 deaths per year.<sup>19</sup>
  - Environmental tobacco smoke (also referred to as secondhand smoke) is a known human carcinogen, estimated to be responsible for approximately 3,000 lung cancer deaths in non-smokers each year as well as posing significant respiratory health risks to young children, including bronchitis, pneumonia, and asthma.<sup>20</sup>
- Asthma:
  - Indoor contaminants such as dust mites, molds, cockroaches, pet dander and secondhand smoke can trigger asthma attacks.<sup>21</sup>
  - More than 20 million people, including over 6 million children, have asthma, accounting for over 10 million outpatient clinic visits, nearly 2 million emergency department visits and nearly 4,500 deaths annually (2000).<sup>22</sup>

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<sup>16</sup> Indoor Environments Division Web site. Indoor Environments Division, U.S. Environmental Protection Agency. <http://www.epa.gov/iaq/>.

<sup>17</sup> National Survey of Lead-Based Paint in Housing. U.S. Environmental Protection Agency. 1995. <http://www.epa.gov/lead/r95-003.pdf>.

<sup>18</sup> Indoor air pollution is associated with certain health effects. However, the complexities involved in tracing a symptom back to the right pollutant source, factoring in variables that affect exposure levels, such as ventilation rates and unique characteristics of buildings and individuals, make this a difficult topic to summarize.

<sup>19</sup> EPA Assessment of Risks from Radon in Homes. U.S. Environmental Protection Agency. June 2003 [http://www.epa.gov/radon/risk\\_assessment.html](http://www.epa.gov/radon/risk_assessment.html).

<sup>20</sup> Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders. U.S. Environmental Protection Agency. 1993.

<sup>21</sup> Clearing the Air: Asthma and Indoor Air Exposures. Institute of Medicine, National Academy of Sciences. 2000. <http://www.iom.edu/report.asp?id=5511>

<sup>22</sup> 2001 National Health Interview Survey (NHIS). National Center for Health Statistics, Center for Disease Control. <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm>

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- Asthma is the most common serious chronic disease of childhood, and the third-ranking cause of hospitalization among children under 15. An estimated 14 million school days are missed each year due to asthma.<sup>23</sup>

### Waste

- Building-related construction and demolition (C&D) debris totals approximately 136 million tons per year, accounting for nearly 60 percent of total non-industrial waste generation in the U.S. (1996).<sup>24 25</sup>
- Approximately 43 percent of C&D debris is generated from residential sources, and 57 percent from non-residential sources (1996).<sup>26</sup>
- Sources of the building-related C&D debris wastestream include demolition (accounting for approximately 48 percent of the waste stream per year), renovation (44 percent), and new construction (8 percent) (1996).<sup>27</sup>
- An estimated 20 to 30 percent of building-related C&D debris is recovered for processing and recycling (1996). The materials most frequently recovered and recycled were concrete, asphalt, metals, and wood.<sup>28</sup>

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<sup>23</sup> Healthy Youth! Health Topics: Asthma. National Center for Chronic Disease Prevention and Health Promotion, Center for Disease Control. <http://www.cdc.gov/HealthyYouth/asthma/>.

<sup>24</sup> Building-related construction & demolition debris includes debris from building construction, renovation and demolition, but does not include debris related to road, bridge or other infrastructure development. Characterization of Building-Related Construction and Demolition Debris in the United States. Office of Solid Waste, U.S. Environmental Protection Agency. July 1998. <http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf>.

<sup>25</sup> Municipal Solid Waste in the United States: 2001 Facts and Figures. Office of Solid Waste, U.S. Environmental Protection Agency. October 2003. <http://www.epa.gov/epaoswer/non-hw/muncpl/msw99.htm>.

<sup>26</sup> Characterization of Building-Related Construction and Demolition Debris in the United States. Office of Solid Waste, U.S. Environmental Protection Agency. July 1998. <http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf>.

<sup>27</sup> Characterization of Building-Related Construction and Demolition Debris in the United States. Office of Solid Waste, U.S. Environmental Protection Agency. July 1998. <http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf>.

<sup>28</sup> Characterization of Building-Related Construction and Demolition Debris in the United States. Office of Solid Waste, U.S. Environmental Protection Agency. July 1998. <http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf>.